FIG. 1

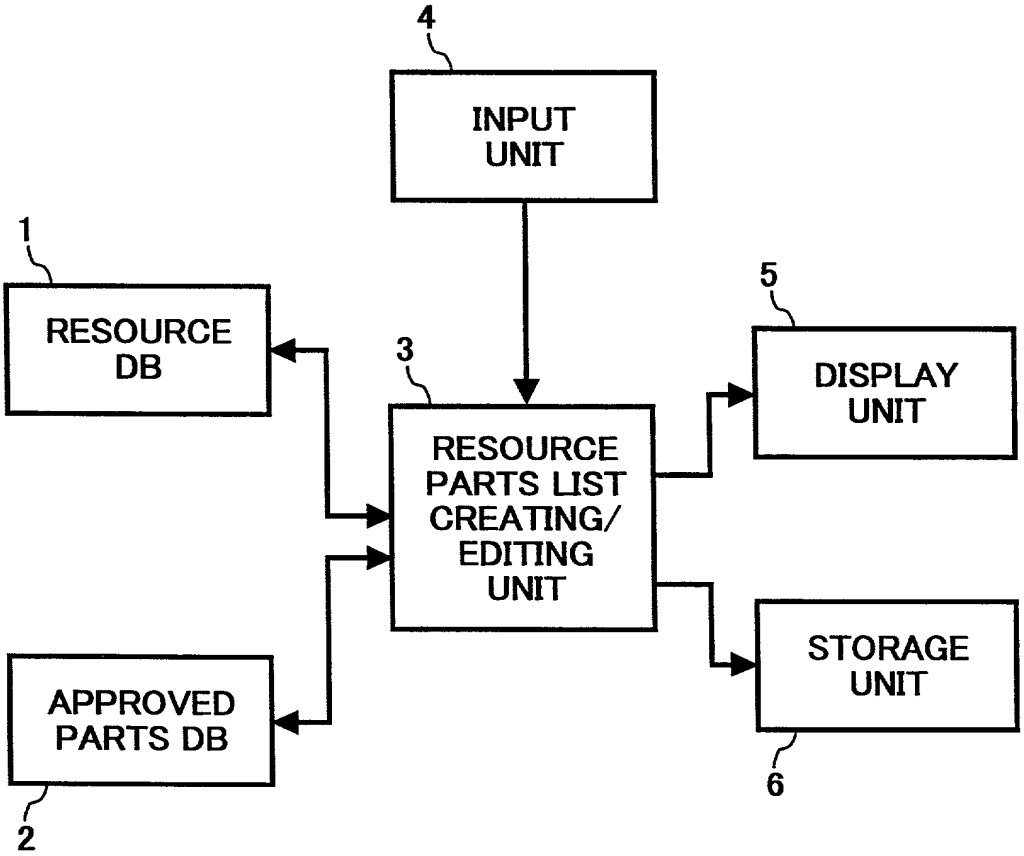
4
INPUT UNIT
1
RESOURCE DB
5
DISPLAY UNIT
3
RESOURCE PARTS LIST CREATING/ EDITING UNIT
STORAGE UNIT
APPROVED PARTS DB
2
6

FIG. 2

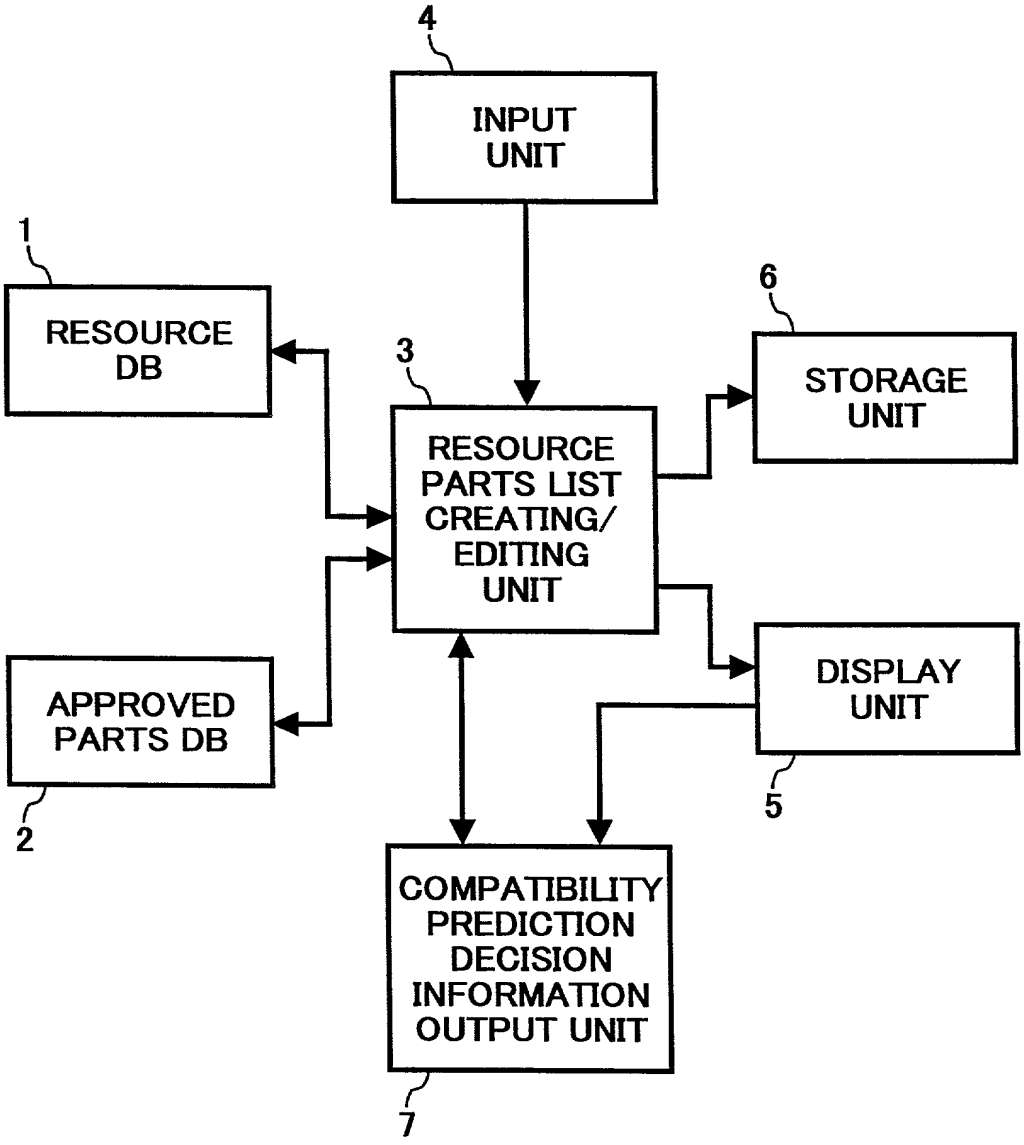
4
INPUT UNIT
1
RESOURCE DB
6
STORAGE UNIT
3
RESOURCE PARTS LIST CREATING/ EDITING UNIT
APPROVED PARTS DB
2
DISPLAY UNIT
5
COMPATIBILITY PREDICTION DECISION INFORMATION OUTPUT UNIT
7

FIG. 3A

	FUNCTION LEVEL 1	FUNCTION LEVEL 2	FUNCTION LEVEL 3	
1	READ	IMAGE SENSOR		SENSING
2	READ	ANALOGUE SIGNAL PROCESSING	DIRTY BACKGROUND REMOVAL	ELECTRICAL

FIG. 3B

QUANTITY

	FUNCTIONAL DEVICE	MAKER	MAKER'S MODEL NUMBER	MAKER'S PART NUMBER	UNIT PRICE	
1	CCD LINEAR IMAGE SENSOR	A CO.	XXXXXX	XXXXXX	XXXX	1
2	CUSTOM IC	B CO.	XXXXXX	XXXXXX	XXXX	1

FIG. 3C

	PCB	USER'S PART NUMBER	UNIT
1	PRINTED BOARD: XX TYPE	XXXXXX	SCANNER
2	PRINTED BOARD: XX TYPE	XXXXXX	SCANNER

FIG. 4

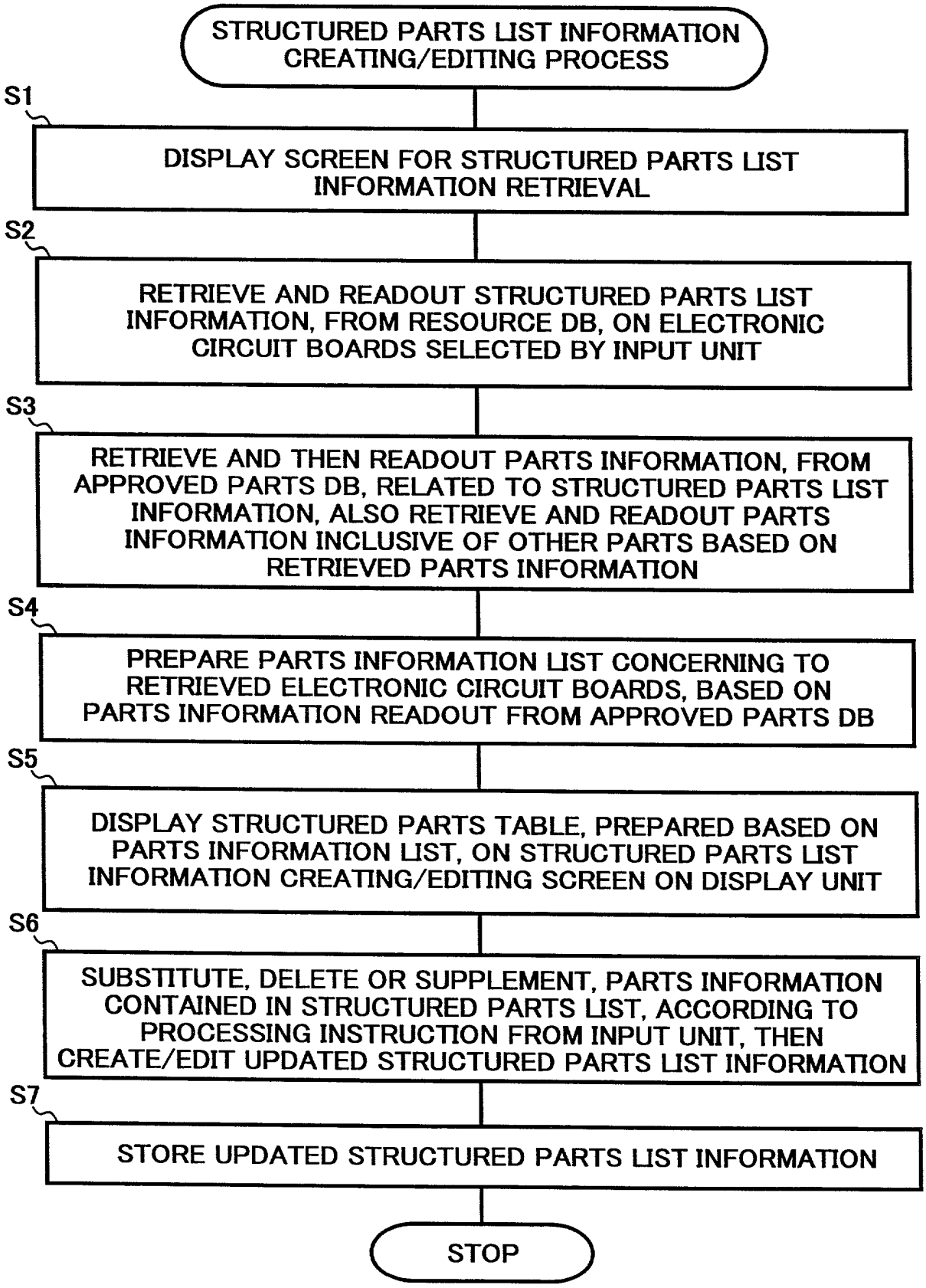
STRUCTURED PARTS LIST INFORMATION CREATING/EDITING PROCESS
S1
DISPLAY SCREEN FOR STRUCTURED PARTS LIST INFORMATION RETRIEVAL
S2
RETRIEVE AND READOUT STRUCTURED PARTS LIST INFORMATION, FROM RESOURCE DB, ON ELECTRONIC CIRCUIT BOARDS SELECTED BY INPUT UNIT
S3
RETRIEVE AND THEN READOUT PARTS INFORMATION, FROM APPROVED PARTS DB, RELATED TO STRUCTURED PARTS LIST INFORMATION, ALSO RETRIEVE AND READOUT PARTS INFORMATION INCLUSIVE OF OTHER PARTS BASED ON RETRIEVED PARTS INFORMATION
S4
PREPARE PARTS INFORMATION LIST CONCERNING TO RETRIEVED ELECTRONIC CIRCUIT BOARDS, BASED ON PARTS INFORMATION READOUT FROM APPROVED PARTS DB
S5
DISPLAY STRUCTURED PARTS TABLE, PREPARED BASED ON PARTS INFORMATION LIST, ON STRUCTURED PARTS LIST INFORMATION CREATING/EDITING SCREEN ON DISPLAY UNIT
S6
SUBSTITUTE, DELETE OR SUPPLEMENT, PARTS INFORMATION CONTAINED IN STRUCTURED PARTS LIST, ACCORDING TO PROCESSING INSTRUCTION FROM INPUT UNIT, THEN CREATE/EDIT UPDATED STRUCTURED PARTS LIST INFORMATION
S7
STORE UPDATED STRUCTURED PARTS LIST INFORMATION
STOP

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FIG. 5

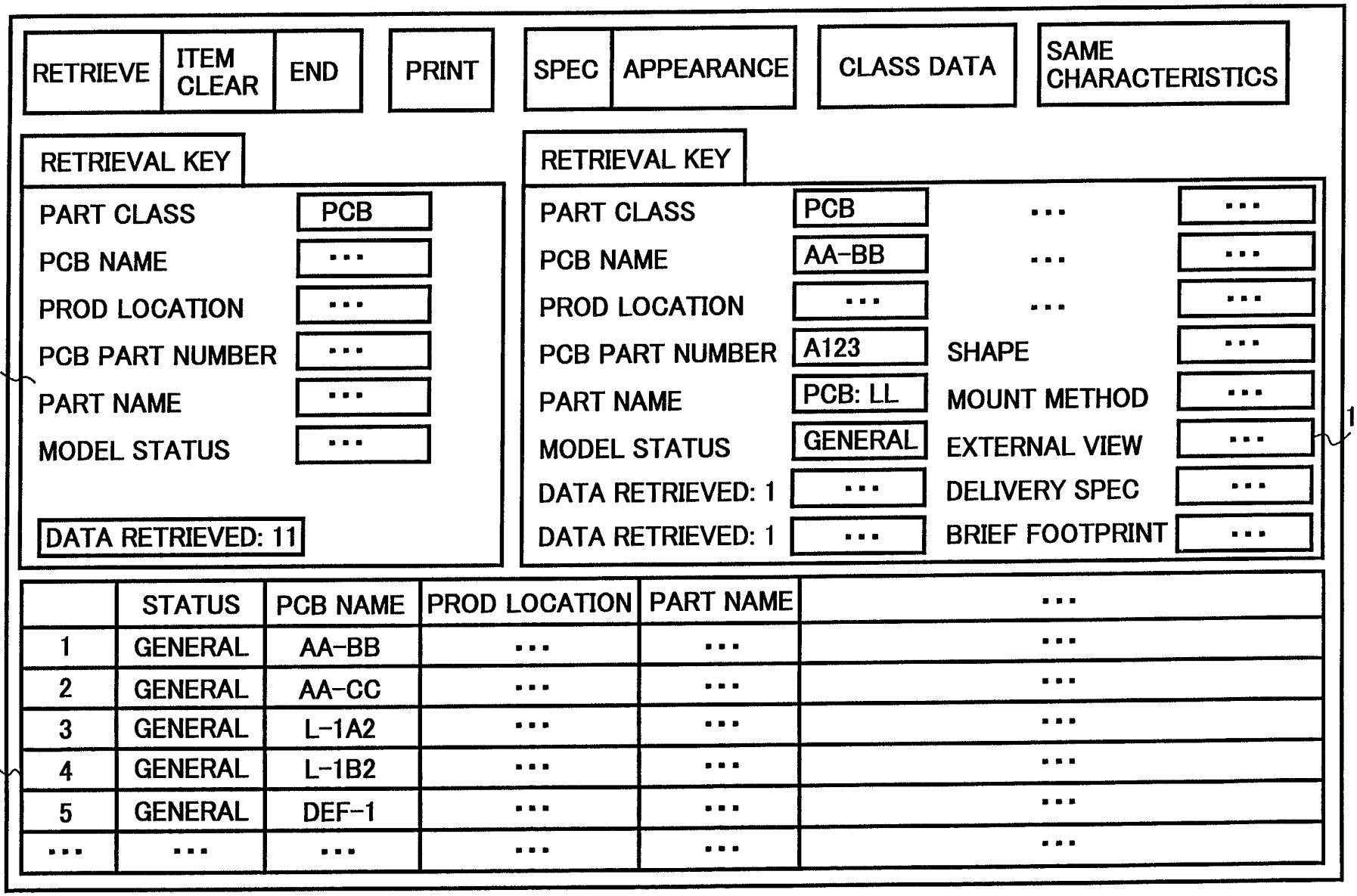

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FIG. 6

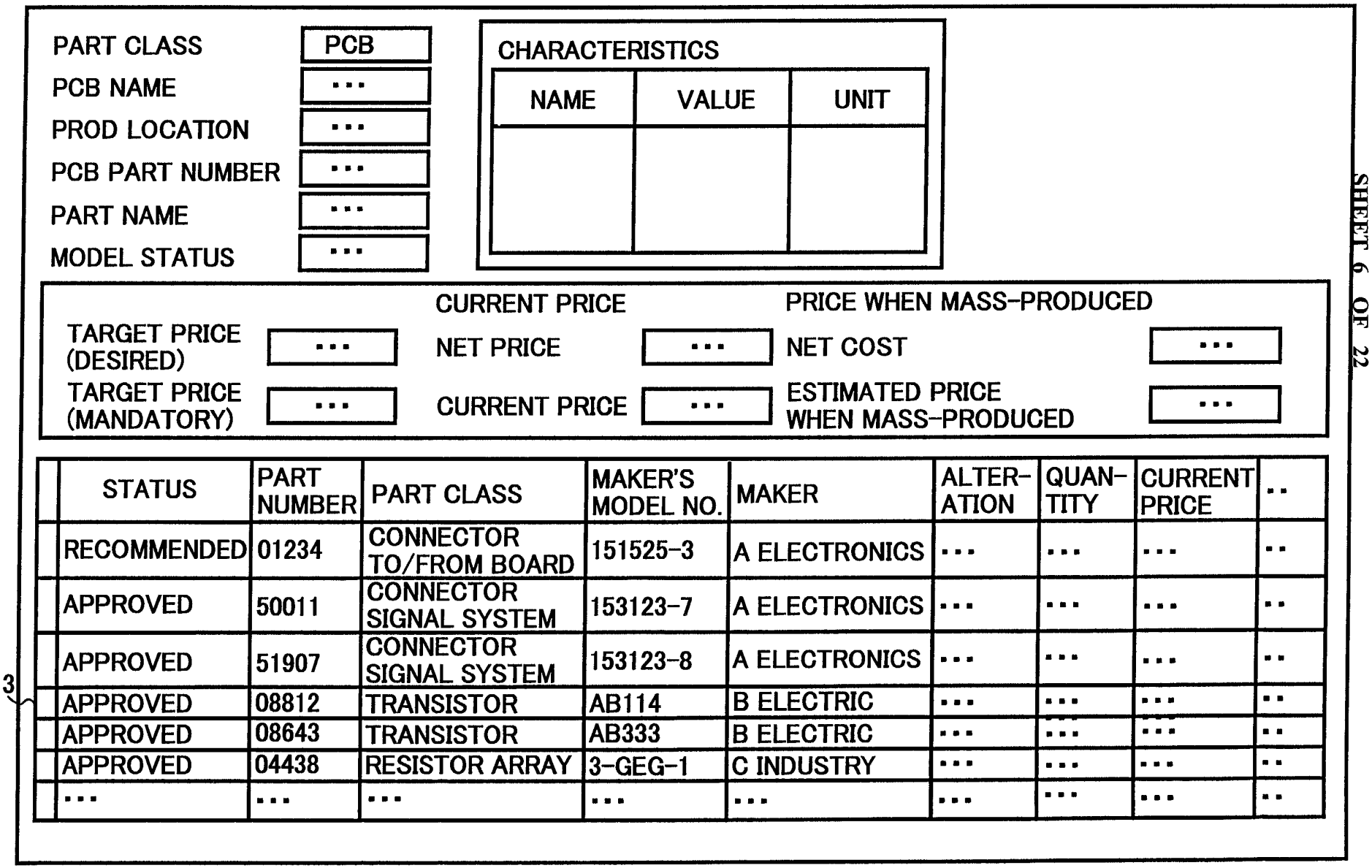

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FIG. 7

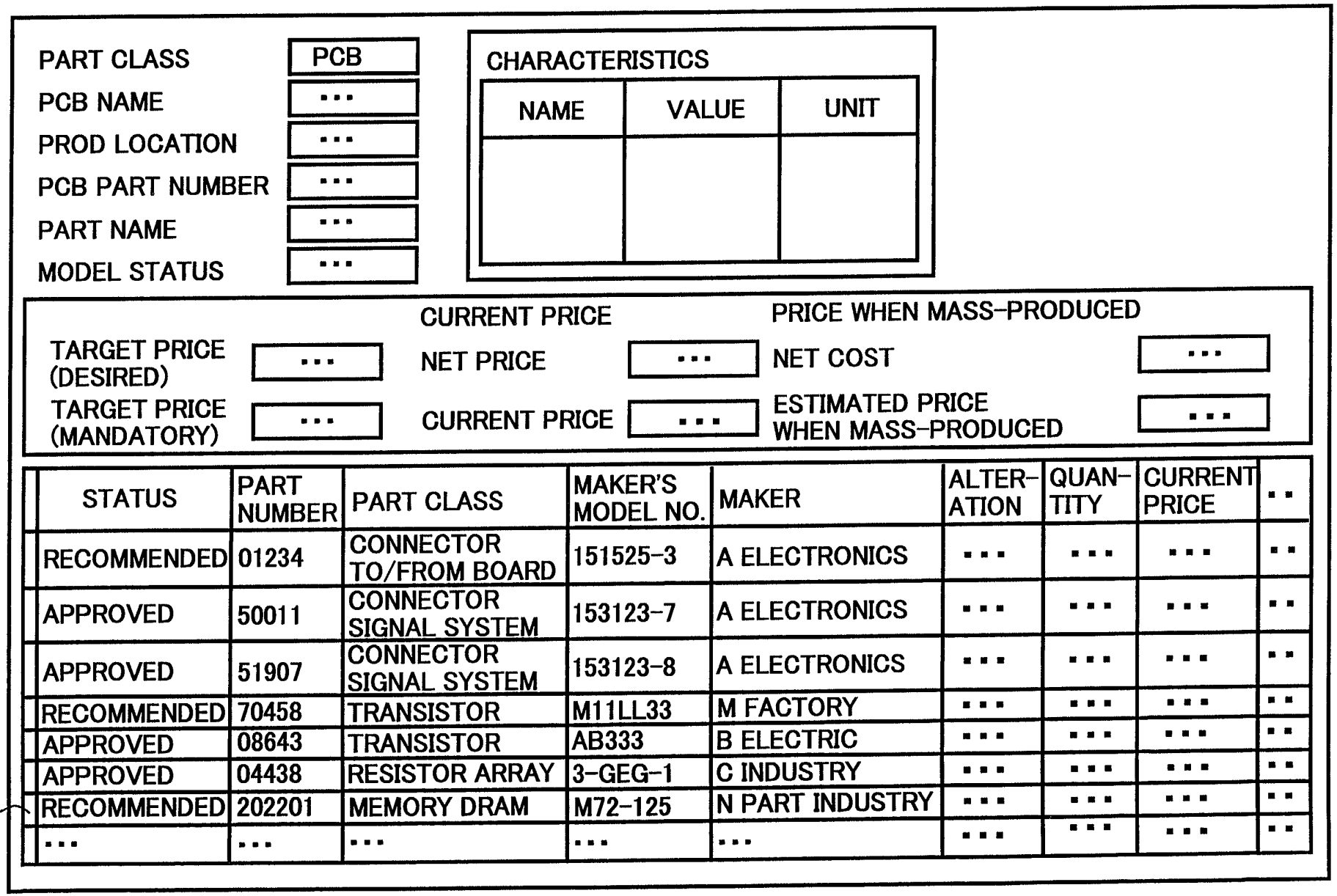

FIG. 8

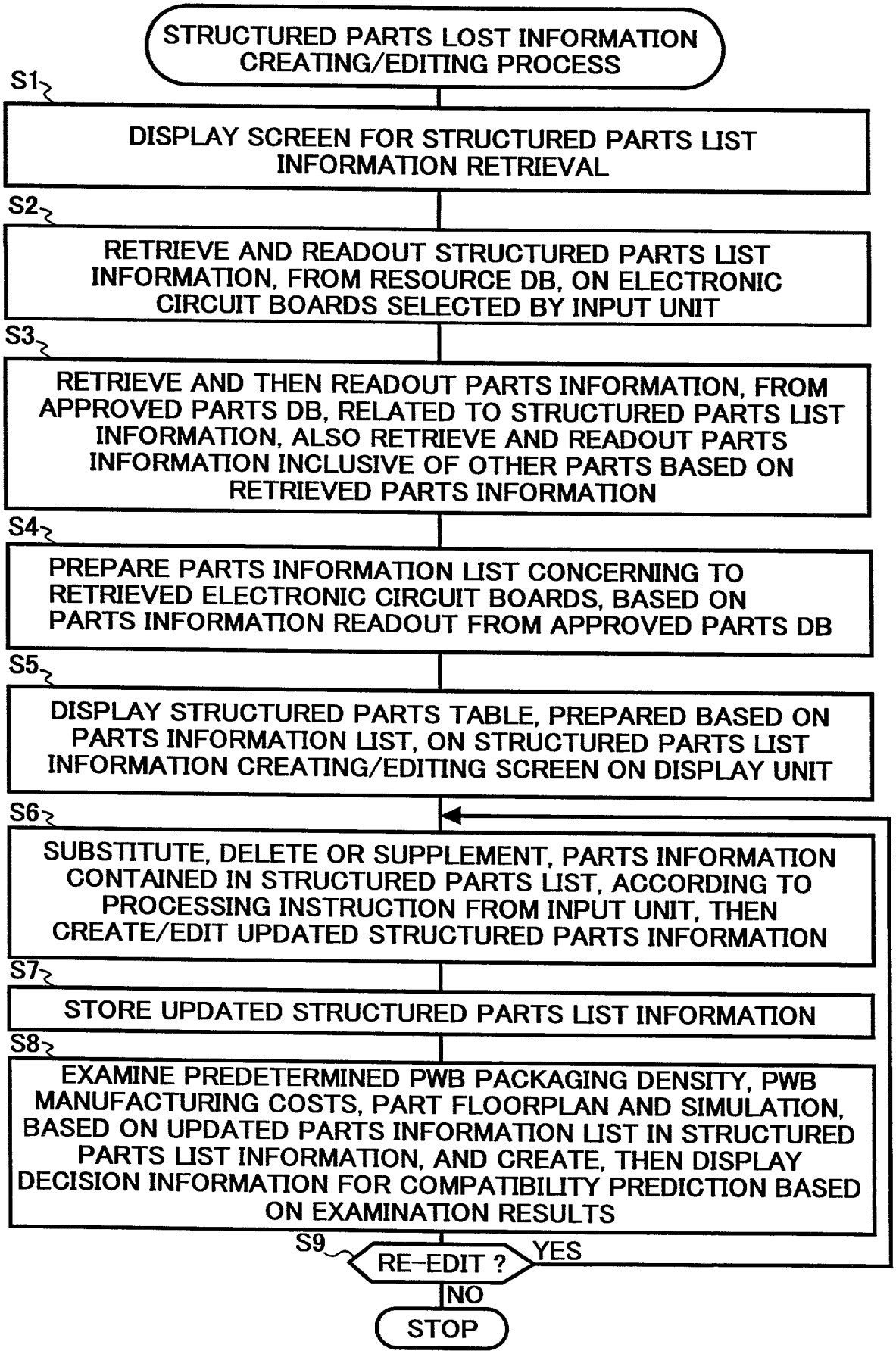
STRUCTURED PARTS LOST INFORMATION CREATING/EDITING PROCESS
S1
DISPLAY SCREEN FOR STRUCTURED PARTS LIST INFORMATION RETRIEVAL
S2
RETRIEVE AND READOUT STRUCTURED PARTS LIST INFORMATION, FROM RESOURCE DB, ON ELECTRONIC CIRCUIT BOARDS SELECTED BY INPUT UNIT
S3
RETRIEVE AND THEN READOUT PARTS INFORMATION, FROM APPROVED PARTS DB, RELATED TO STRUCTURED PARTS LIST INFORMATION, ALSO RETRIEVE AND READOUT PARTS INFORMATION INCLUSIVE OF OTHER PARTS BASED ON RETRIEVED PARTS INFORMATION
S4
PREPARE PARTS INFORMATION LIST CONCERNING TO RETRIEVED ELECTRONIC CIRCUIT BOARDS, BASED ON PARTS INFORMATION READOUT FROM APPROVED PARTS DB
S5
DISPLAY STRUCTURED PARTS TABLE, PREPARED BASED ON PARTS INFORMATION LIST, ON STRUCTURED PARTS LIST INFORMATION CREATING/EDITING SCREEN ON DISPLAY UNIT
S6
SUBSTITUTE, DELETE OR SUPPLEMENT, PARTS INFORMATION CONTAINED IN STRUCTURED PARTS LIST, ACCORDING TO PROCESSING INSTRUCTION FROM INPUT UNIT, THEN CREATE/EDIT UPDATED STRUCTURED PARTS INFORMATION
S7
STORE UPDATED STRUCTURED PARTS LIST INFORMATION
S8
EXAMINE PREDETERMINED PWB PACKAGING DENSITY, PWB MANUFACTURING COSTS, PART FLOORPLAN AND SIMULATION, BASED ON UPDATED PARTS INFORMATION LIST IN STRUCTURED PARTS LIST INFORMATION, AND CREATE, THEN DISPLAY DECISION INFORMATION FOR COMPATIBILITY PREDICTION BASED ON EXAMINATION RESULTS
S9
RE-EDIT ?
YES
NO
STOP

FIG. 9A

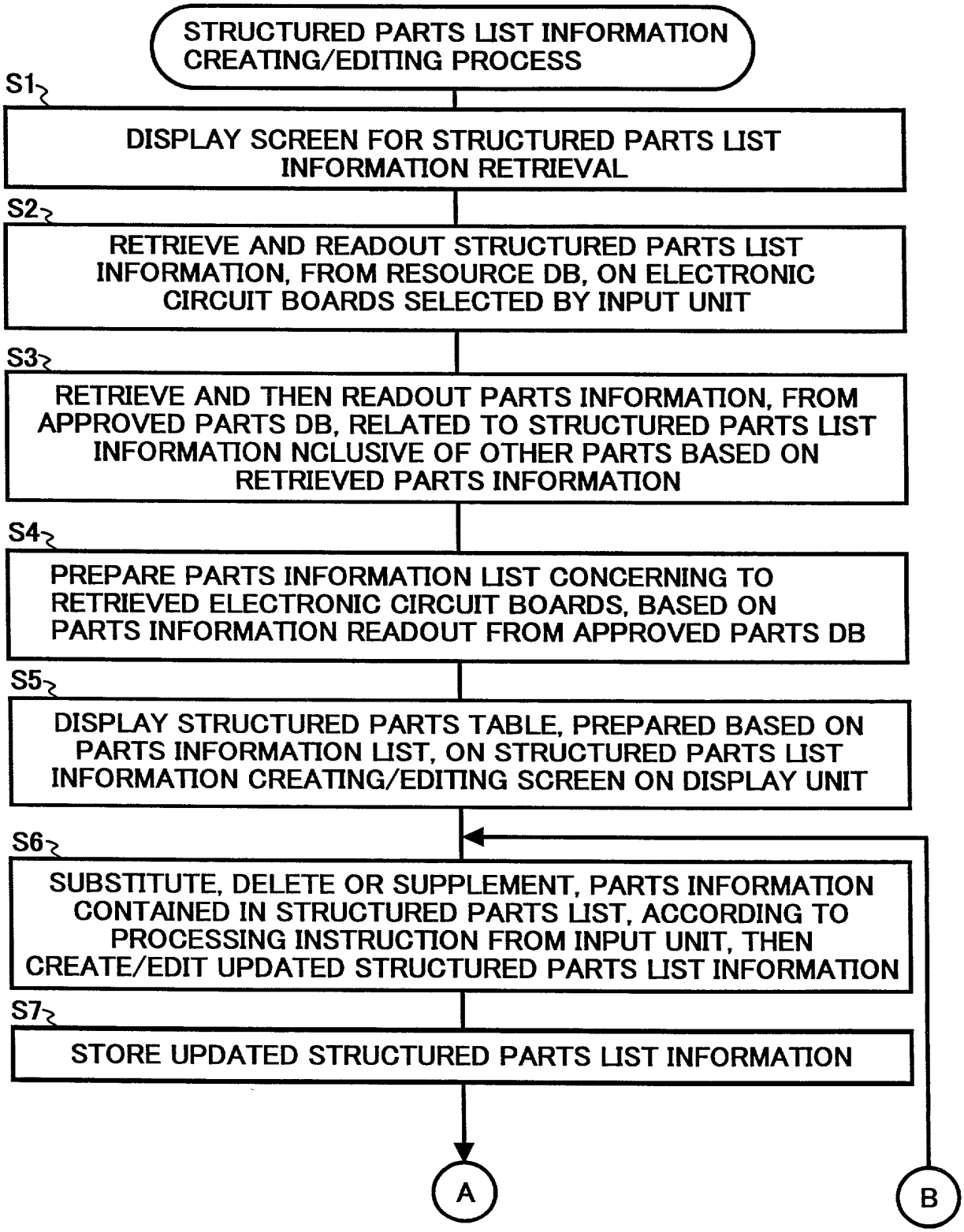
STRUCTURED PARTS LIST INFORMATION CREATING/EDITING PROCESS
S1
DISPLAY SCREEN FOR STRUCTURED PARTS LIST INFORMATION RETRIEVAL
S2
RETRIEVE AND READOUT STRUCTURED PARTS LIST INFORMATION, FROM RESOURCE DB, ON ELECTRONIC CIRCUIT BOARDS SELECTED BY INPUT UNIT
S3
RETRIEVE AND THEN READOUT PARTS INFORMATION, FROM APPROVED PARTS DB, RELATED TO STRUCTURED PARTS LIST INFORMATION NCLUSIVE OF OTHER PARTS BASED ON RETRIEVED PARTS INFORMATION
S4
PREPARE PARTS INFORMATION LIST CONCERNING TO RETRIEVED ELECTRONIC CIRCUIT BOARDS, BASED ON PARTS INFORMATION READOUT FROM APPROVED PARTS DB
S5
DISPLAY STRUCTURED PARTS TABLE, PREPARED BASED ON PARTS INFORMATION LIST, ON STRUCTURED PARTS LIST INFORMATION CREATING/EDITING SCREEN ON DISPLAY UNIT
S6
SUBSTITUTE, DELETE OR SUPPLEMENT, PARTS INFORMATION CONTAINED IN STRUCTURED PARTS LIST, ACCORDING TO PROCESSING INSTRUCTION FROM INPUT UNIT, THEN CREATE/EDIT UPDATED STRUCTURED PARTS LIST INFORMATION
S7
STORE UPDATED STRUCTURED PARTS LIST INFORMATION
A
B

FIG. 9B

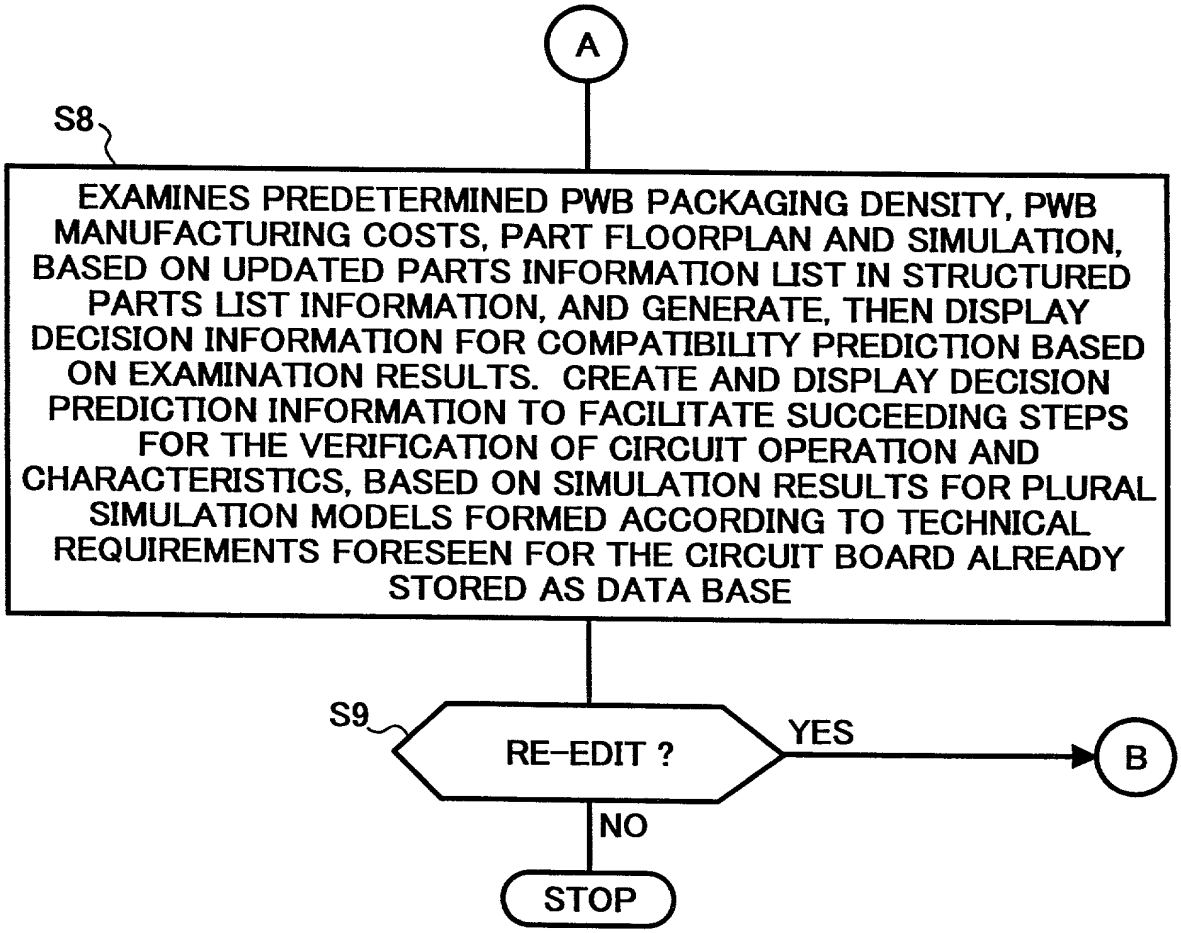
A
S8
EXAMINES PREDETERMINED PWB PACKAGING DENSITY, PWB MANUFACTURING COSTS, PART FLOORPLAN AND SIMULATION, BASED ON UPDATED PARTS INFORMATION LIST IN STRUCTURED PARTS LIST INFORMATION, AND GENERATE, THEN DISPLAY DECISION INFORMATION FOR COMPATIBILITY PREDICTION BASED ON EXAMINATION RESULTS. CREATE AND DISPLAY DECISION PREDICTION INFORMATION TO FACILITATE SUCCEEDING STEPS FOR THE VERIFICATION OF CIRCUIT OPERATION AND CHARACTERISTICS, BASED ON SIMULATION RESULTS FOR PLURAL SIMULATION MODELS FORMED ACCORDING TO TECHNICAL REQUIREMENTS FORESEEN FOR THE CIRCUIT BOARD ALREADY STORED AS DATA BASE
S9
RE-EDIT ?
YES
B
NO
STOP

FIG. 10

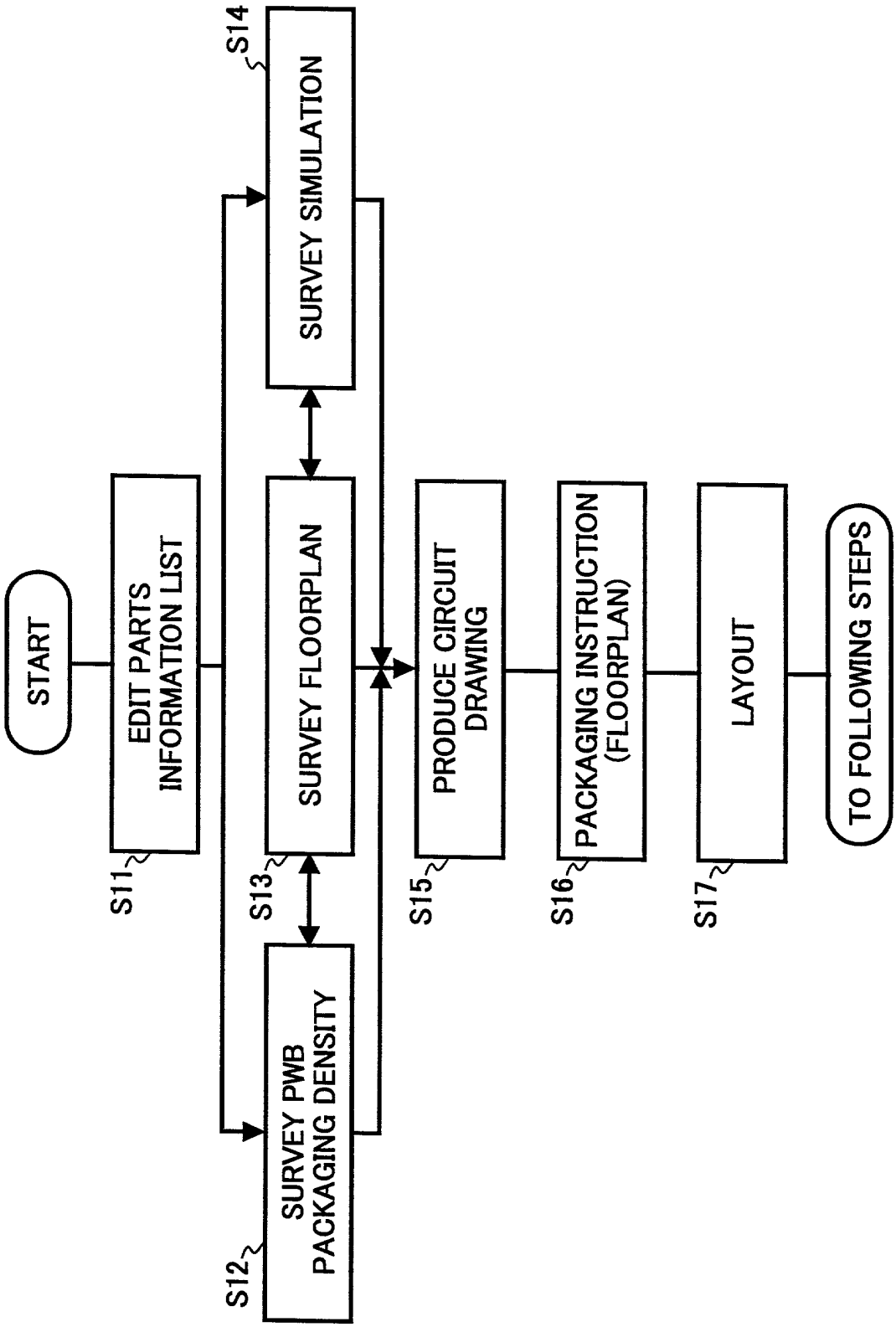
START
EDIT PARTS INFORMATION LIST
S11
SURVEY FLOORPLAN
S13
SURVEY SIMULATION
S14
SURVEY PWB PACKAGING DENSITY
S12
PRODUCE CIRCUIT DRAWING
S15
PACKAGING INSTRUCTION (FLOORPLAN)
S16
LAYOUT
S17
TO FOLLOWING STEPS

FIG. 11

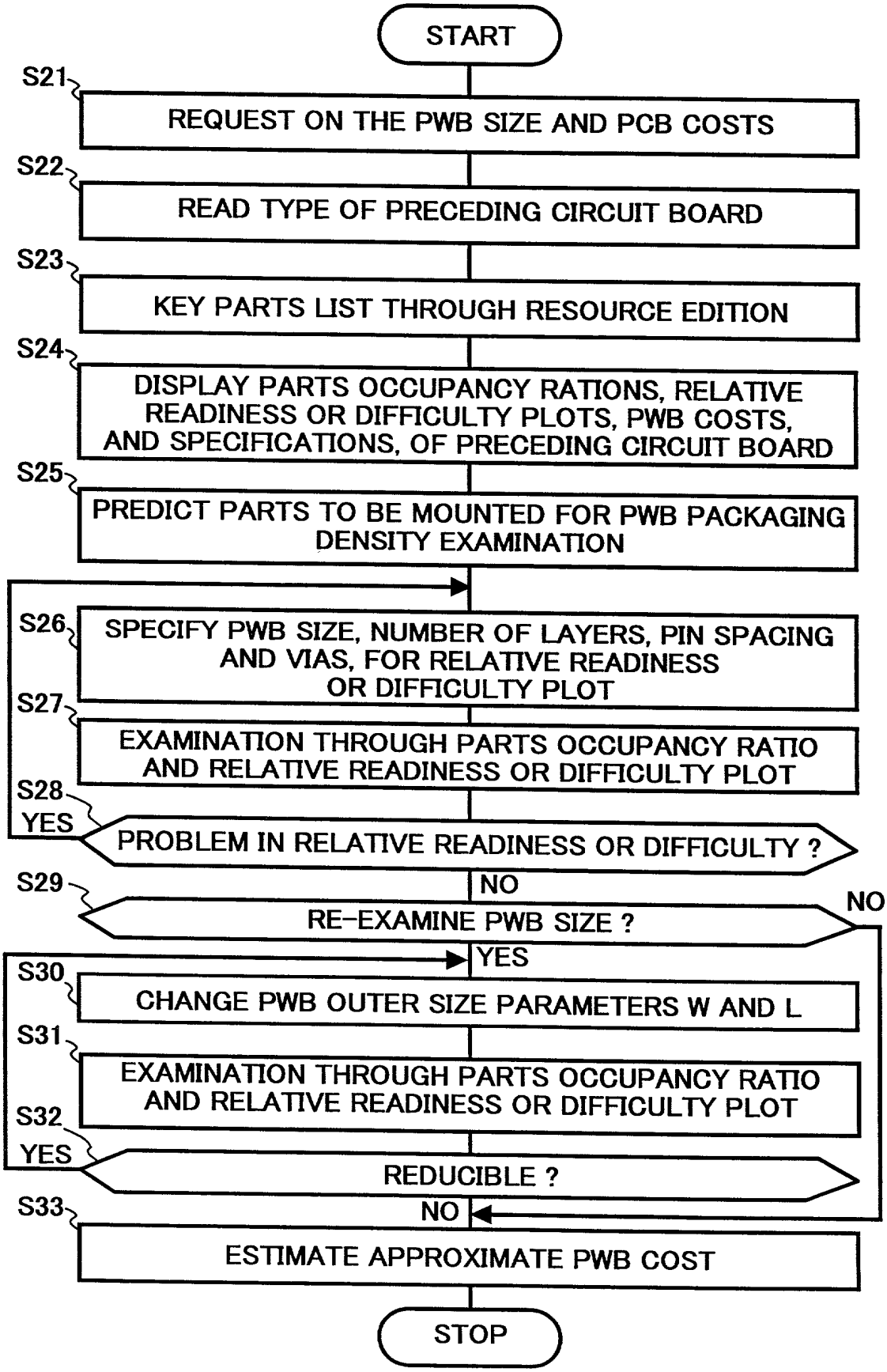
START
S21
REQUEST ON THE PWB SIZE AND PCB COSTS
S22
READ TYPE OF PRECEDING CIRCUIT BOARD
S23
KEY PARTS LIST THROUGH RESOURCE EDITION
S24
DISPLAY PARTS OCCUPANCY RATIONS, RELATIVE READINESS OR DIFFICULTY PLOTS, PWB COSTS, AND SPECIFICATIONS, OF PRECEDING CIRCUIT BOARD
S25
PREDICT PARTS TO BE MOUNTED FOR PWB PACKAGING DENSITY EXAMINATION
S26
SPECIFY PWB SIZE, NUMBER OF LAYERS, PIN SPACING AND VIAS, FOR RELATIVE READINESS OR DIFFICULTY PLOT
S27
EXAMINATION THROUGH PARTS OCCUPANCY RATIO AND RELATIVE READINESS OR DIFFICULTY PLOT
S28
YES
PROBLEM IN RELATIVE READINESS OR DIFFICULTY ?
NO
S29
RE-EXAMINE PWB SIZE ?
NO
YES
S30
CHANGE PWB OUTER SIZE PARAMETERS W AND L
S31
EXAMINATION THROUGH PARTS OCCUPANCY RATIO AND RELATIVE READINESS OR DIFFICULTY PLOT
S32
YES
REDUCIBLE ?
NO
S33
ESTIMATE APPROXIMATE PWB COST
STOP

FIG. 12

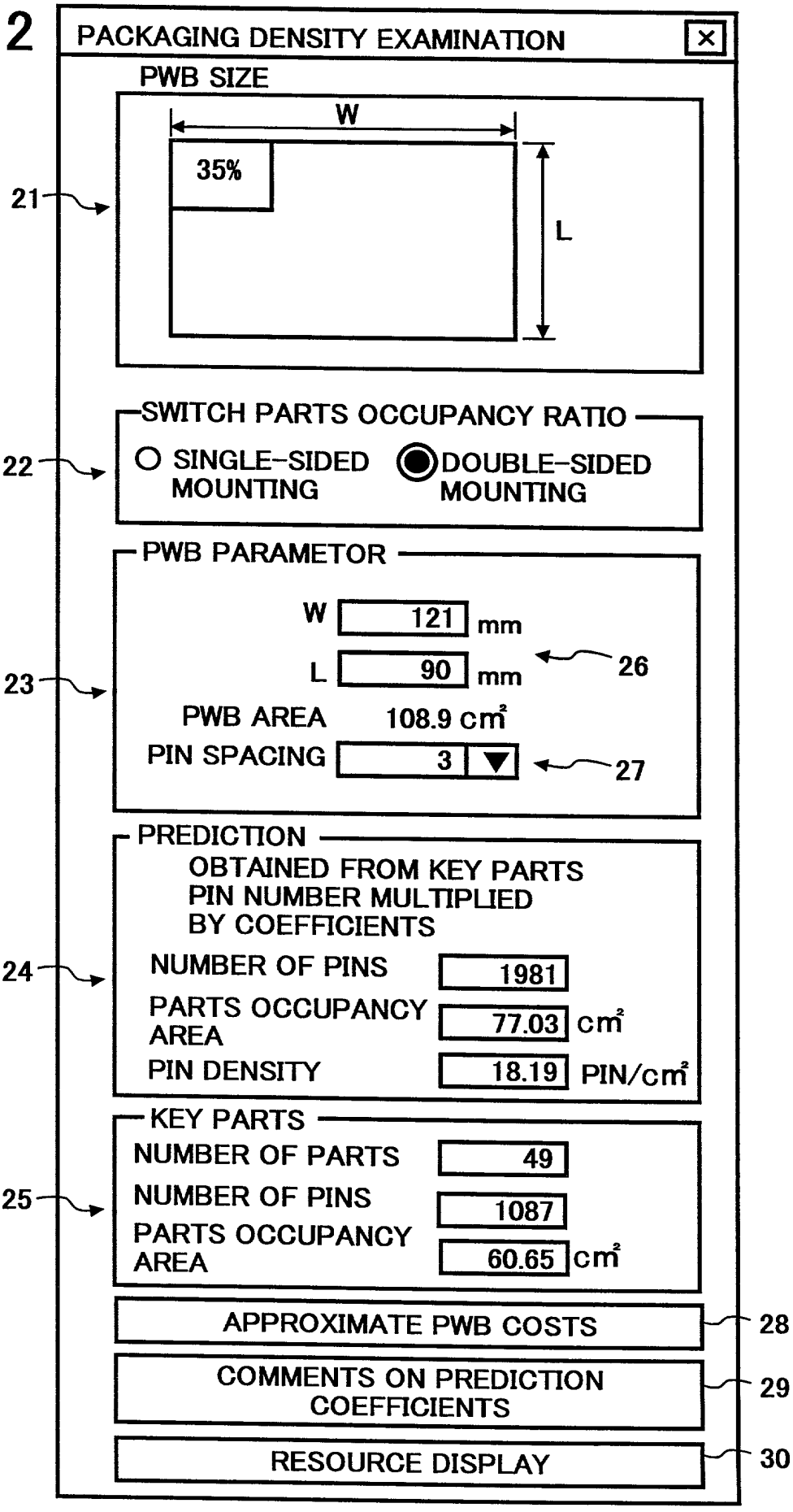
PACKAGING DENSITY EXAMINATION
PWB SIZE
W
35%
L
21
SWITCH PARTS OCCUPANCY RATIO
SINGLE-SIDED MOUNTING
DOUBLE-SIDED MOUNTING
22
PWB PARAMETOR
W 121 mm
L 90 mm
26
23
PWB AREA 108.9 cm²
PIN SPACING 3
27
PREDICTION
OBTAINED FROM KEY PARTS PIN NUMBER MULTIPLIED BY COEFFICIENTS
NUMBER OF PINS 1981
PARTS OCCUPANCY AREA 77.03 cm²
PIN DENSITY 18.19 PIN/cm²
24
KEY PARTS
NUMBER OF PARTS 49
NUMBER OF PINS 1087
PARTS OCCUPANCY AREA 60.65 cm²
25
APPROXIMATE PWB COSTS
28
COMMENTS ON PREDICTION COEFFICIENTS
29
RESOURCE DISPLAY
30

FIG.13A

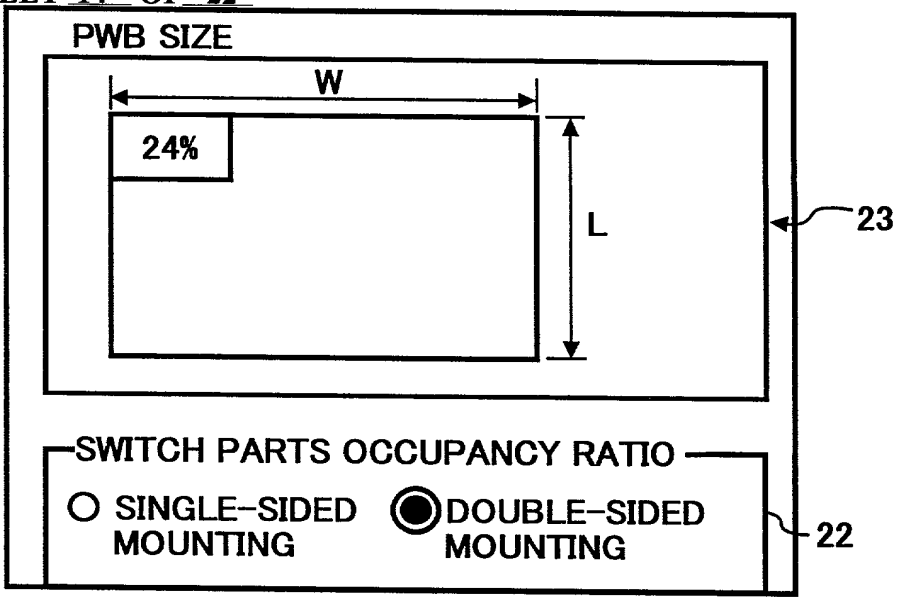

FIG.13B

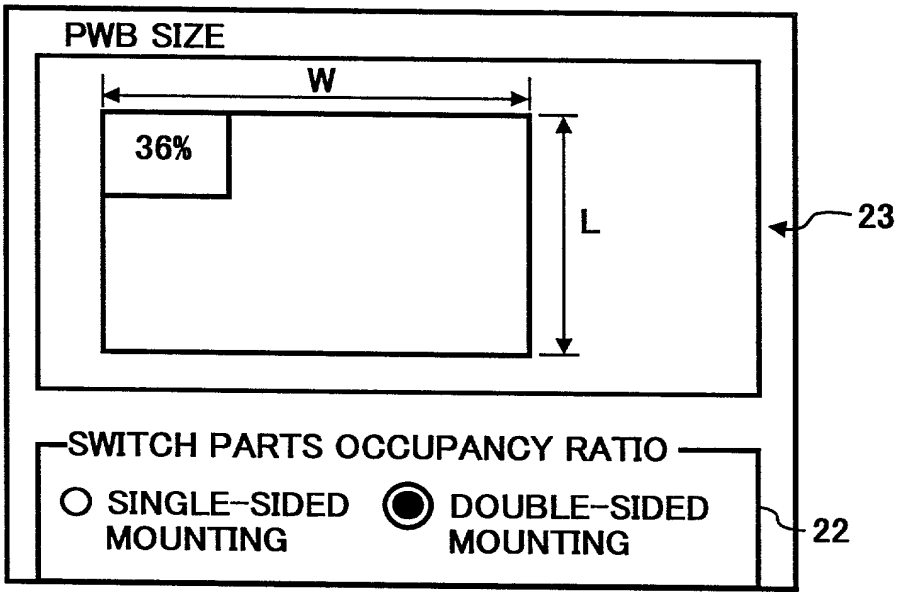

FIG.13C

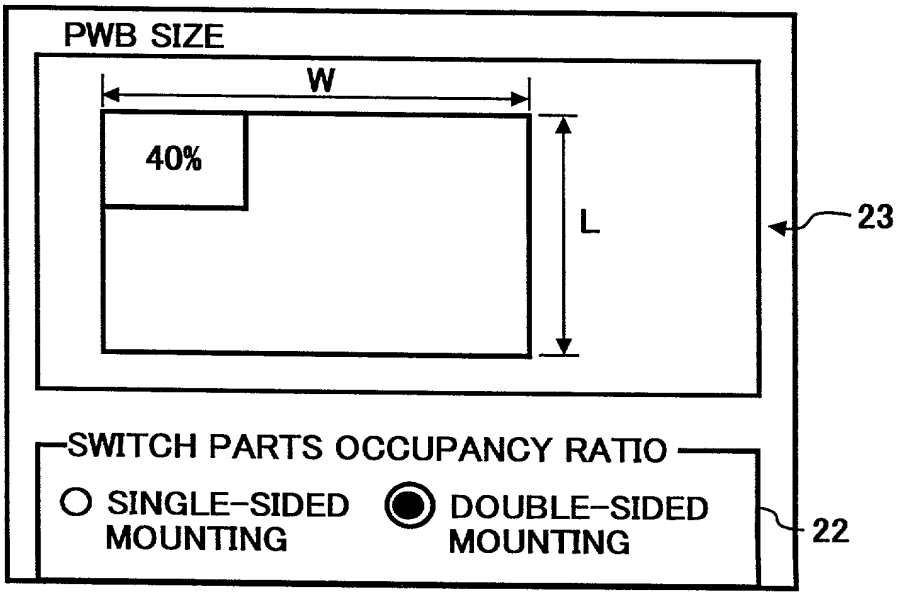

FIG. 14

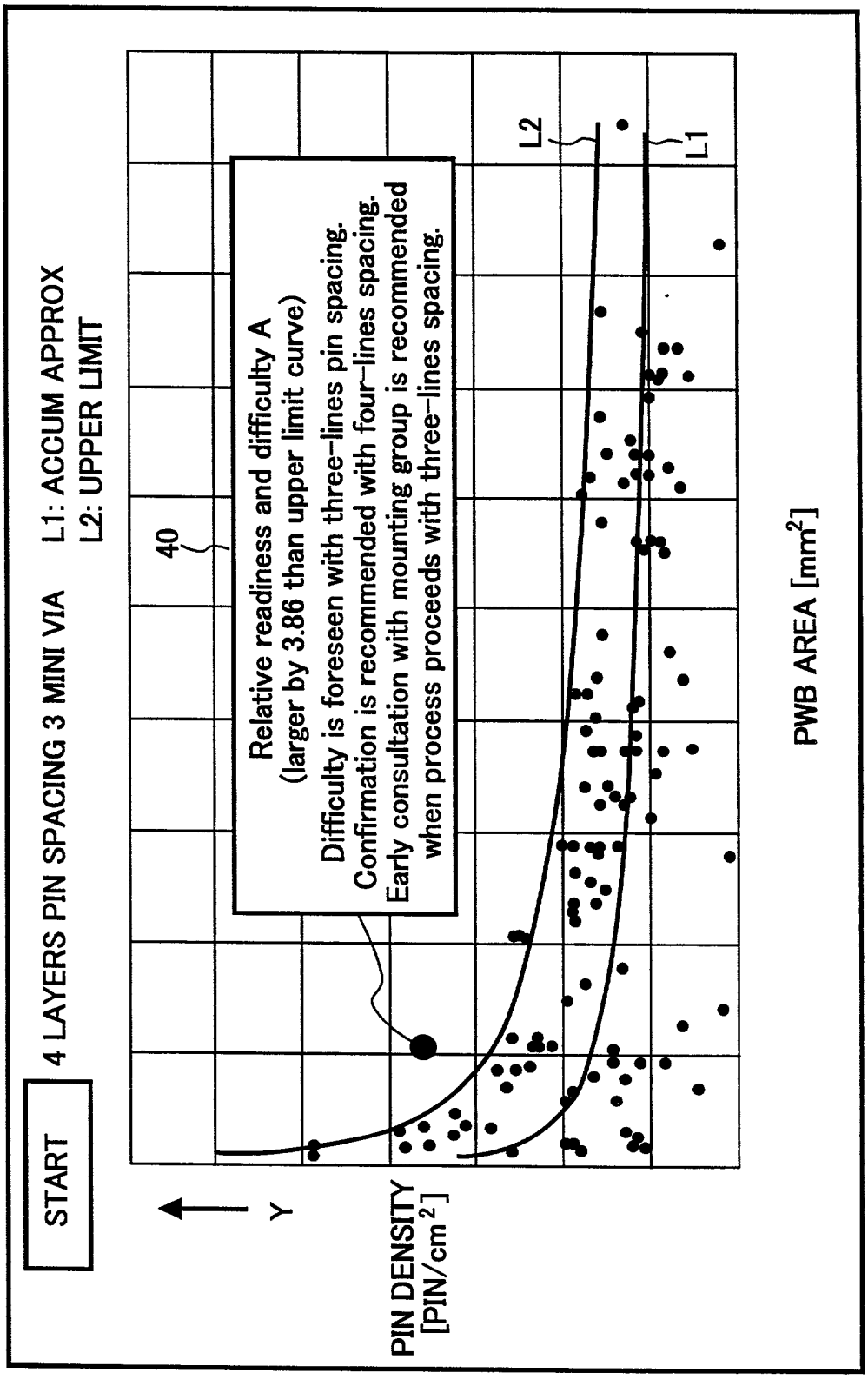
START
4 LAYERS PIN SPACING 3 MINI VIA
L1: ACCUM APPROX
L2: UPPER LIMIT
40
Relative readiness and difficulty A
(larger by 3.86 than upper limit curve)
Difficulty is foreseen with three-lines pin spacing.
Confirmation is recommended with four-lines spacing.
Early consultation with mounting group is recommended
when process proceeds with three-lines spacing.
L2
L1
Y
PIN DENSITY
[PIN/cm^2]
PWB AREA [mm^2]

FIG. 15

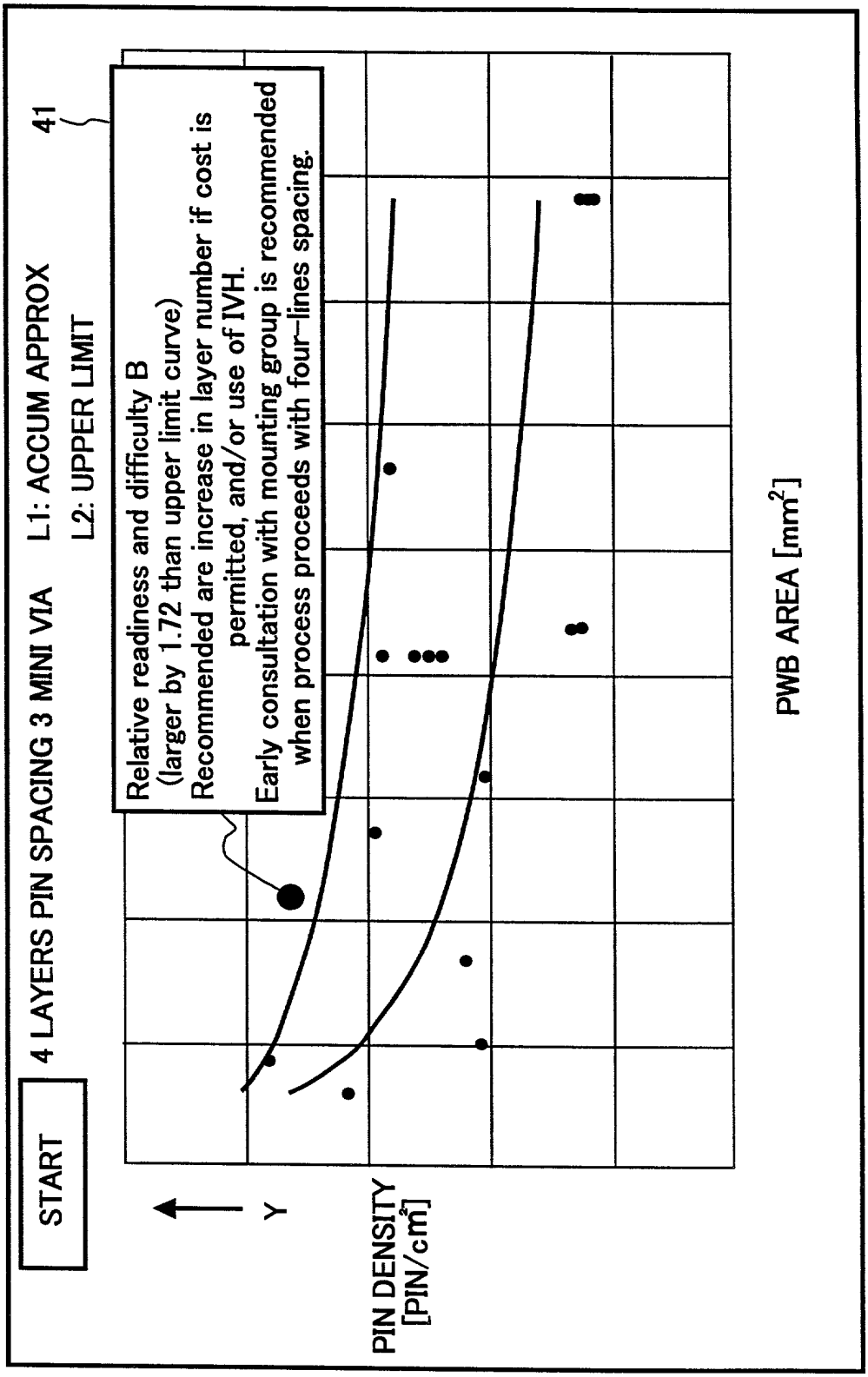
START
4 LAYERS PIN SPACING 3 MINI VIA
L1: ACCUM APPROX
L2: UPPER LIMIT
41
Relative readiness and difficulty B
(larger by 1.72 than upper limit curve)
Recommended are increase in layer number if cost is permitted, and/or use of IVH.
Early consultation with mounting group is recommended when process proceeds with four-lines spacing.
Y
PIN DENSITY [PIN/cm²]
PWB AREA [mm²]

FIG. 16

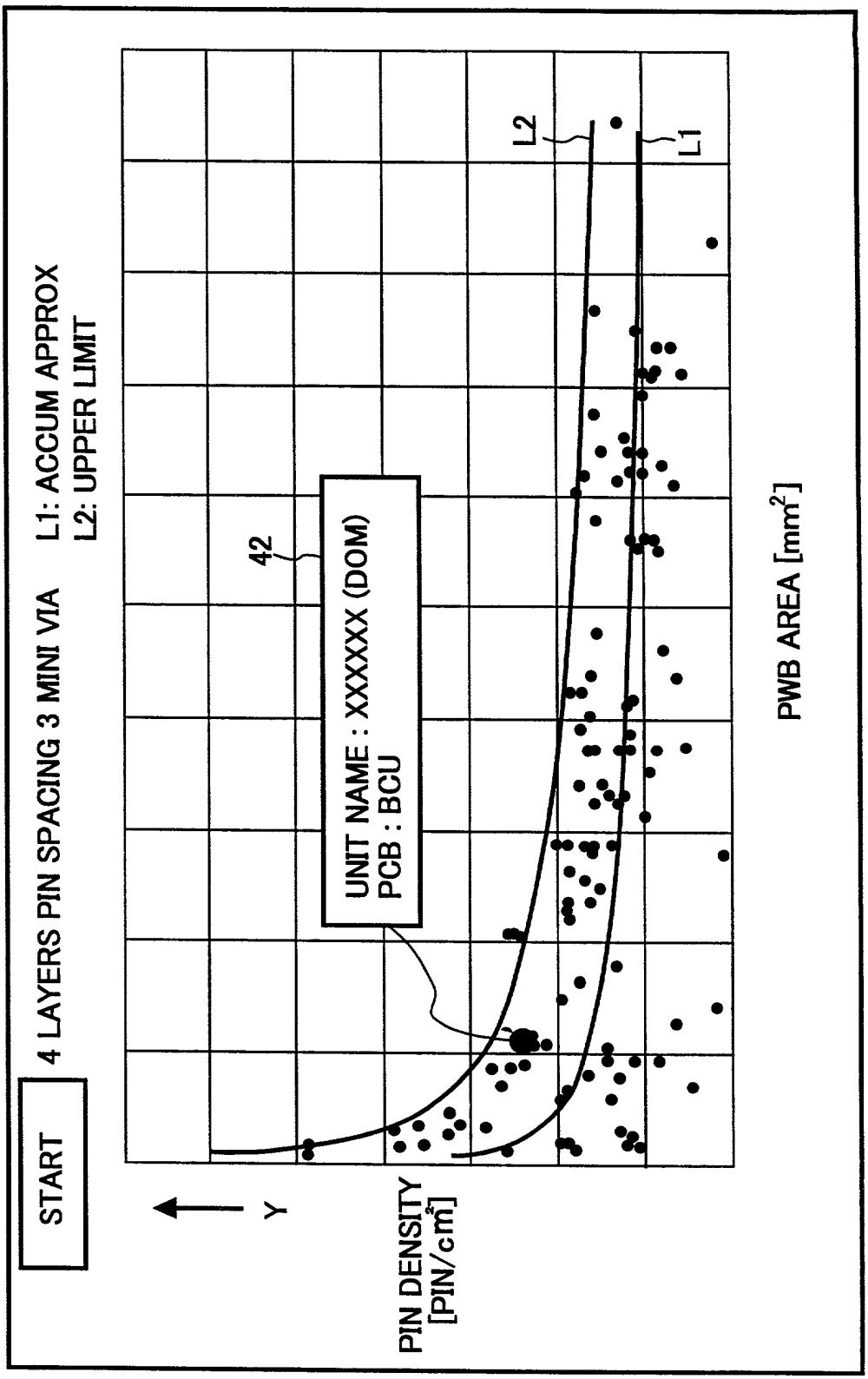
START
4 LAYERS PIN SPACING 3 MINI VIA
L1: ACCUM APPROX
L2: UPPER LIMIT
42
UNIT NAME : XXXXXX (DOM)
PCB : BCU
L2
L1
Y
PIN DENSITY [PIN/cm²]
PWB AREA [mm²]

FIG. 17

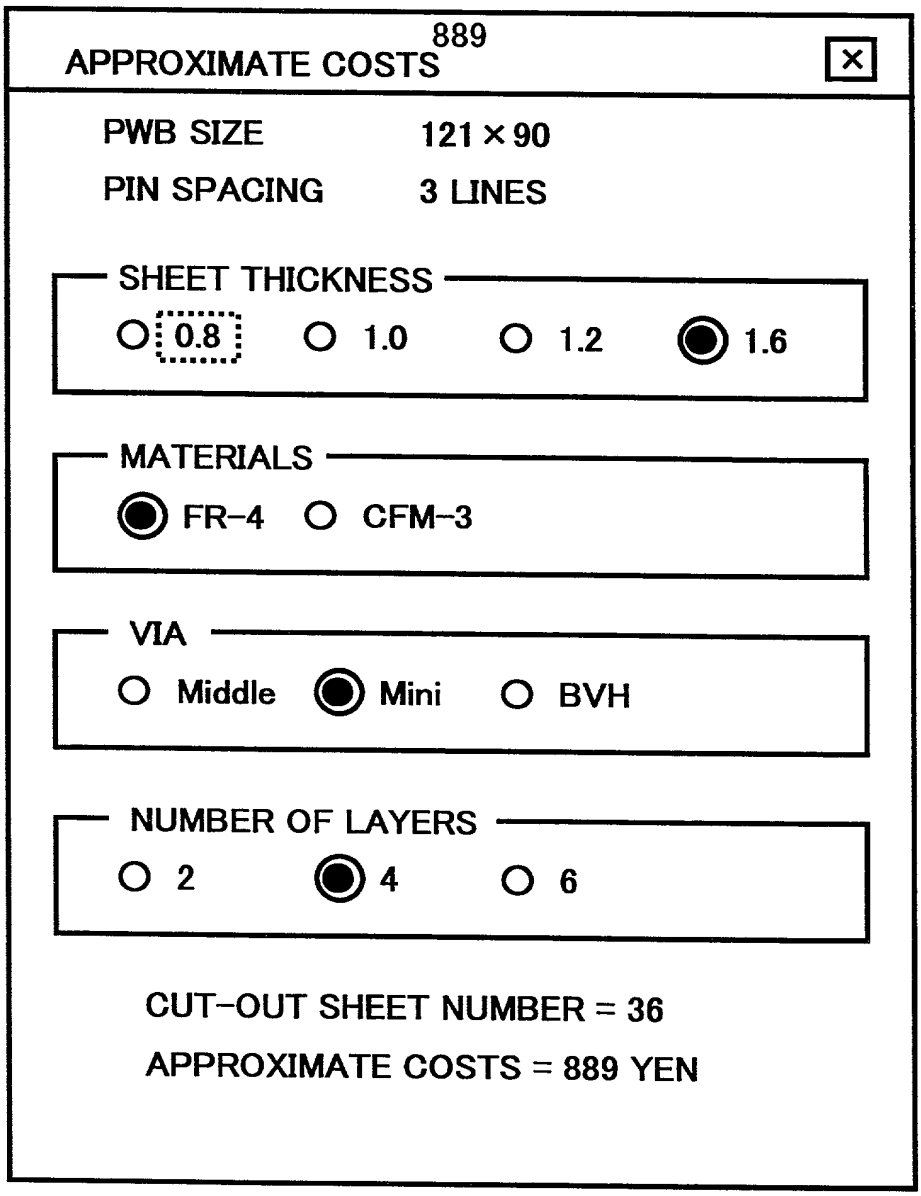
889
APPROXIMATE COSTS
PWB SIZE
121 × 90
PIN SPACING
3 LINES
SHEET THICKNESS
0.8
1.0
1.2
1.6
MATERIALS
FR-4
CFM-3
VIA
Middle
Mini
BVH
NUMBER OF LAYERS
2
4
6
CUT-OUT SHEET NUMBER = 36
APPROXIMATE COSTS = 889 YEN

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FIG. 18

PARTS PREDICTION COEFFICIENTS

Number of pins and parts occupancy area are estimated based on key parts arrangement. Accordingly, further calculations based on these values may yield results different from those obtained experimental data.
In the present calculation, therefore, prediction coefficients are used as shown below in the table, which are provided to estimate these values more precisely to realize actual mounting on the PWB by taking into account of predicted number of the parts expected to be mounted.

	RATIO OF PIN NUMBER TO TOTAL KEY PARTS PIN NUMBER	AREA PER PIN	PREDICTED PIN NUMBER	PREDICTED AREA (cm^2)
RESISTOR	1.7	0.8	639	5.11
CAPACITOR	5.2	3.7	209	7.73
OTHER	23.6	7.7	46	3.54

PUSH TO ALTER

ALTER END

FIG. 19A

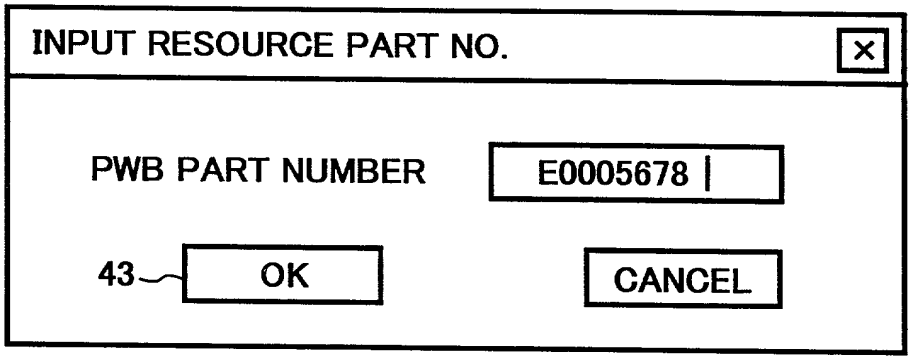


FIG. 19B

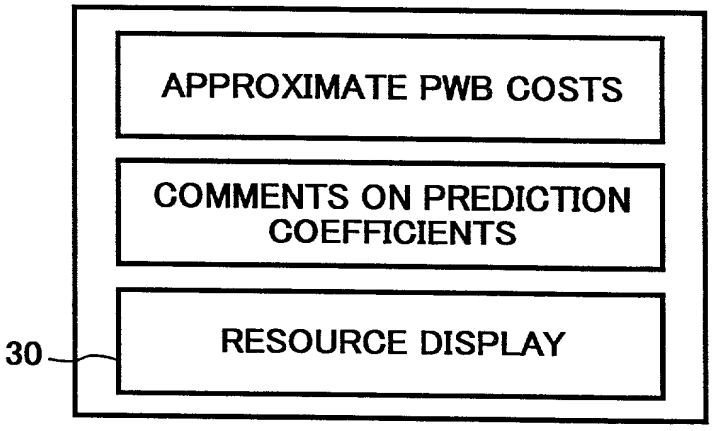


FIG. 19C

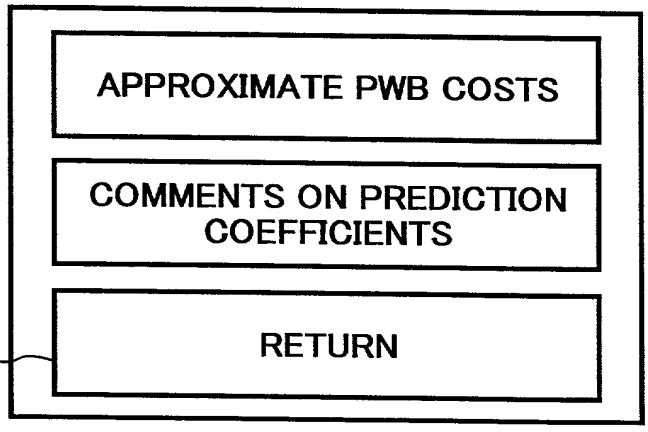


FIG. 20

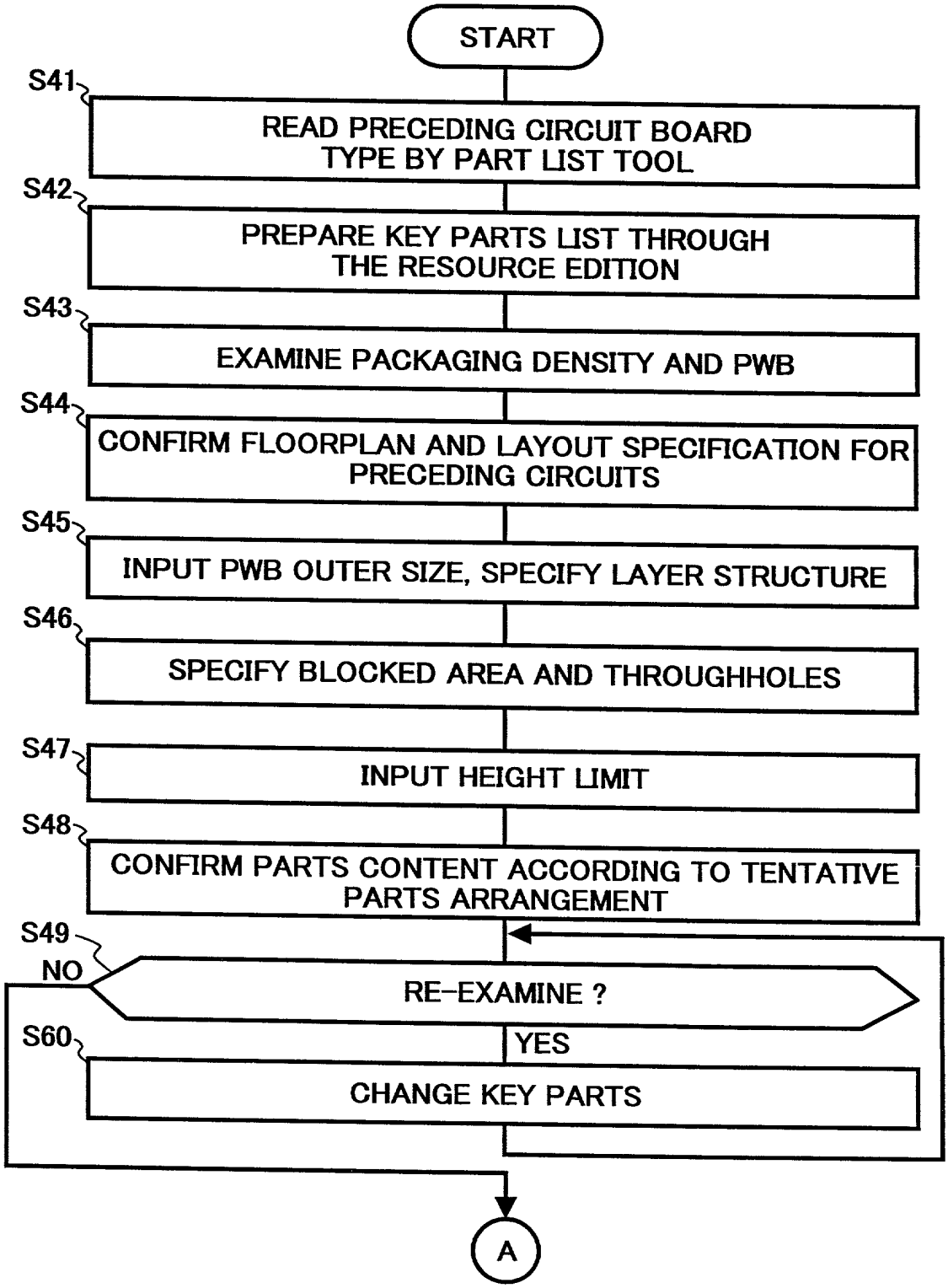
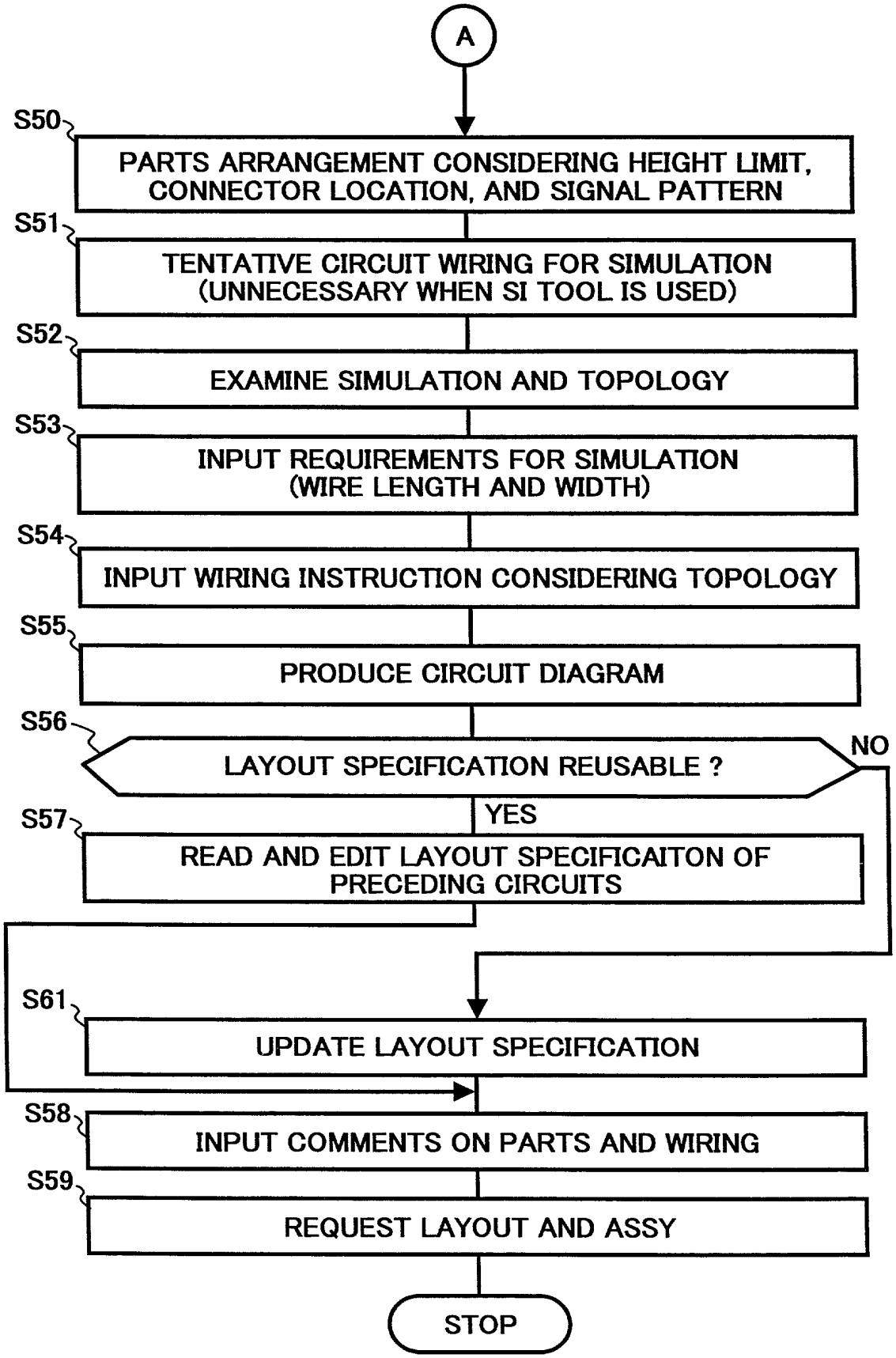

START
S41
READ PRECEDING CIRCUIT BOARD TYPE BY PART LIST TOOL
S42
PREPARE KEY PARTS LIST THROUGH THE RESOURCE EDITION
S43
EXAMINE PACKAGING DENSITY AND PWB
S44
CONFIRM FLOORPLAN AND LAYOUT SPECIFICATION FOR PRECEDING CIRCUITS
S45
INPUT PWB OUTER SIZE, SPECIFY LAYER STRUCTURE
S46
SPECIFY BLOCKED AREA AND THROUGHHOLES
S47
INPUT HEIGHT LIMIT
S48
CONFIRM PARTS CONTENT ACCORDING TO TENTATIVE PARTS ARRANGEMENT
S49
NO
RE-EXAMINE ?
YES
S60
CHANGE KEY PARTS
A

FIG. 21


A
S50
PARTS ARRANGEMENT CONSIDERING HEIGHT LIMIT, CONNECTOR LOCATION, AND SIGNAL PATTERN
S51
TENTATIVE CIRCUIT WIRING FOR SIMULATION (UNNECESSARY WHEN SI TOOL IS USED)
S52
EXAMINE SIMULATION AND TOPOLOGY
S53
INPUT REQUIREMENTS FOR SIMULATION (WIRE LENGTH AND WIDTH)
S54
INPUT WIRING INSTRUCTION CONSIDERING TOPOLOGY
S55
PRODUCE CIRCUIT DIAGRAM
S56
LAYOUT SPECIFICATION REUSABLE ?
NO
YES
S57
READ AND EDIT LAYOUT SPECIFICAITON OF PRECEDING CIRCUITS
S61
UPDATE LAYOUT SPECIFICATION
S58
INPUT COMMENTS ON PARTS AND WIRING
S59
REQUEST LAYOUT AND ASSY
STOP